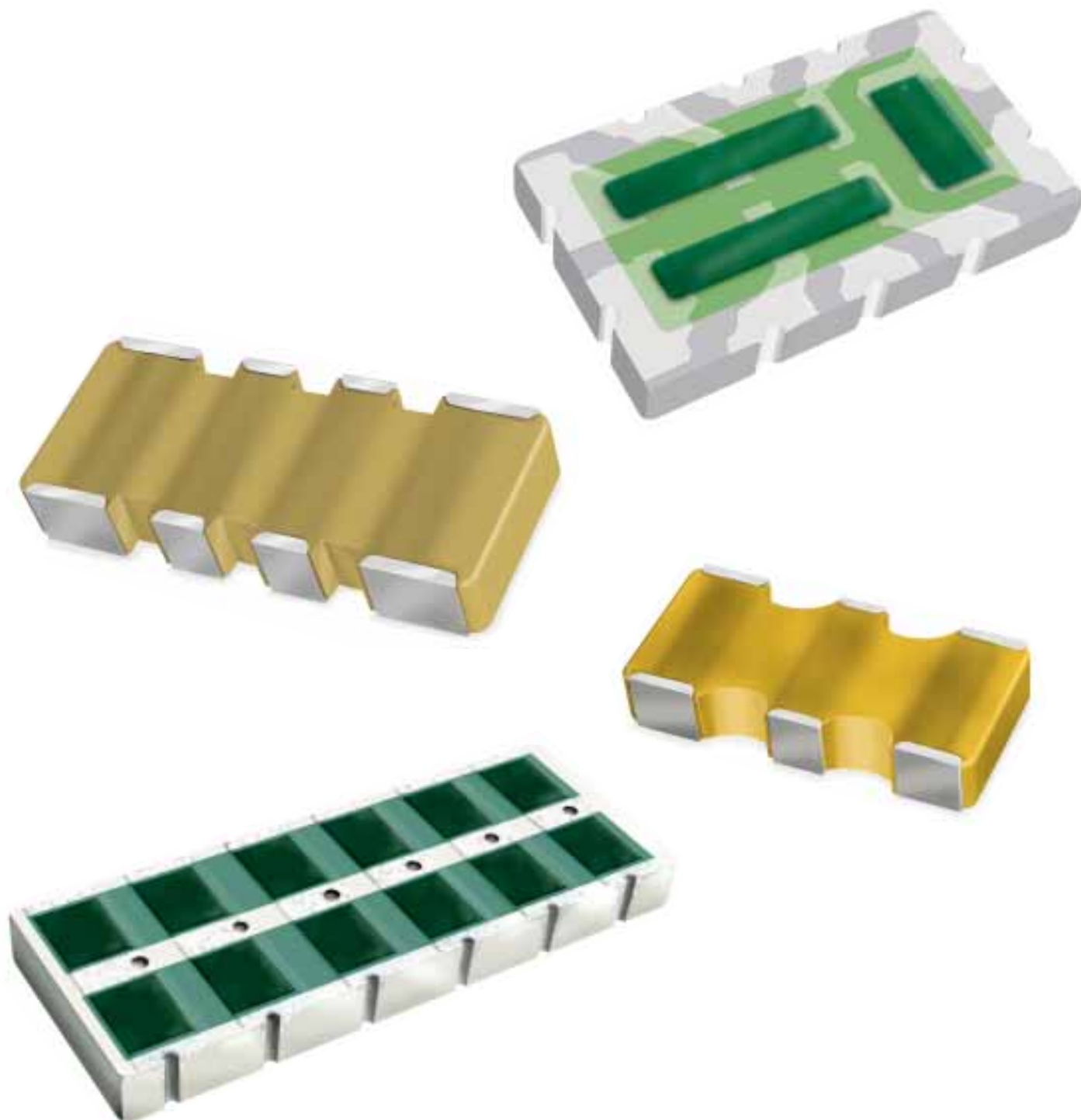


AVX CUSTOM INTEGRATED PASSIVE COMPONENTS



GENERAL DESCRIPTION

An Integrated Passive Component (IPC), as the name suggests, is a device that incorporates more than one passive component into a single substrate. Integration involves either grouping multiple similar passive elements into arrays or networks, or mixing different passive types to form special circuits, filter attenuation networks, etc.

AVX and KYOCERA presently offer various surface mountable, standard IPC products including: MLC capacitor arrays, thick film resistor arrays, transient suppression arrays (Multiguard) etc. Please see the individual data sheets on these products for more information. Your AVX/KYOCERA sales representative can assist you on this.

In addition to the standard products offered, AVX has the capability to manufacture a wide variety of custom IPC's. These include, but are not limited to:

- MLC capacitor arrays with multiple capacitance values in the same array,
- capacitor arrays with tighter tolerances or matching requirements,
- high voltage or hirel versions of standard capacitor arrays,
- capacitor arrays serving as substrates for IC's or other components,
- resistor/capacitor combinations (see below for further explanation on these),
- nonstandard terminations (e.g. PdAg) or forms (e.g. circular).

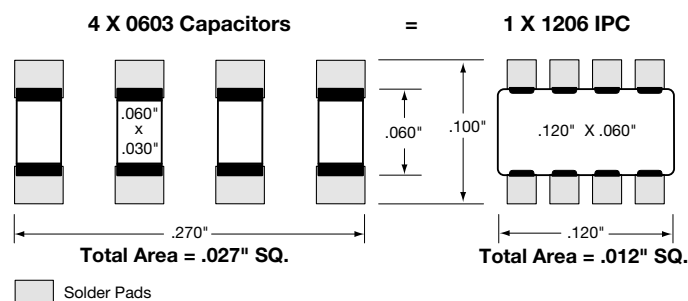
Resistor elements can be added to the basic capacitor substrate to form R-C Networks or simple R-C Circuits for a wide range of applications, such as filters, terminating devices, etc. The substrate portion of these IPC's relies on AVX MLC technology and over thirteen years experience in the manufacture of complex capacitor arrays. To this foundation thick film resistor technology has been adapted.

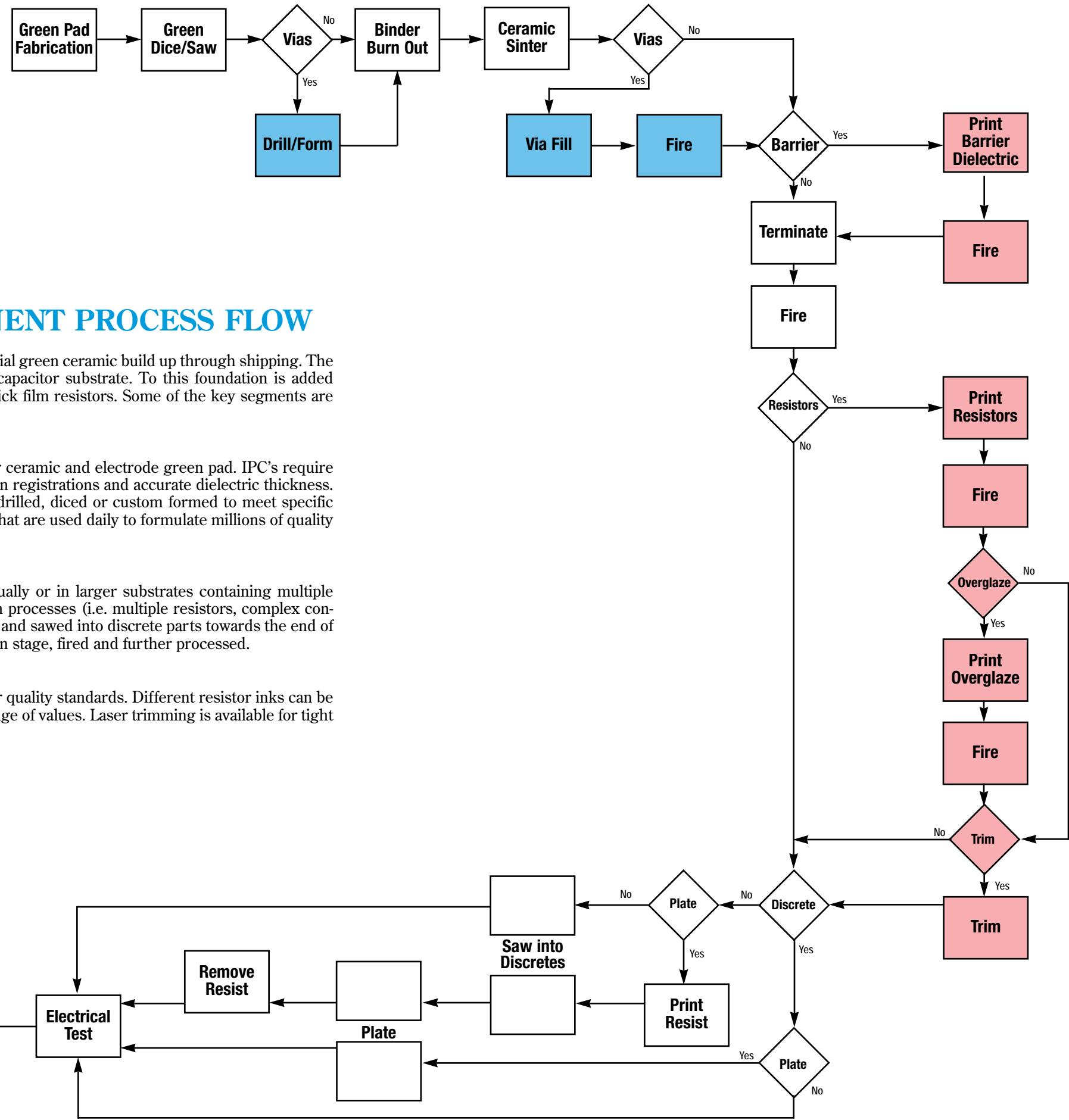
Since 1993, the combination of multiple capacitor substrates with thick film resistors has been used to build increasingly complex circuits. Thus far custom IPC's have been successfully provided:

- with three to eighteen elements (6 caps & 12 resistors and 12 caps & 6 resistors),
- with withstanding voltages as high as 1000 volts,
- with capacitance values ranging as wide as 100 times in the same substrate,
- with tightened capacitance tolerances (e.g. +/-2% for NPO),
- with capacitance matching requirements (e.g. +/-2% for X7R),
- in circular shapes for use in connectors,
- for high reliability requirements for use in implantable pacemakers and defibrillators (over two dozen designs).

Board Space Savings

(e.g. Standard 4-Cap Array)





INTEGRATED PASSIVE COMPONENT PROCESS FLOW

These two pages track the manufacturing sequence for IPC's from initial green ceramic build up through shipping. The heart of the process consists of constructing a multilayer ceramic capacitor substrate. To this foundation is added unique segments based on design, e.g., vias, castellations, and/or thick film resistors. Some of the key segments are discussed below.

GREEN PAD FABRICATION

AVX utilizes proprietary ceramic processes to build up the multilayer ceramic and electrode green pad. IPC's require that these processes are capable of maintaining tight electrode pattern registrations and accurate dielectric thickness. Once the green build up is accomplished, the resulting pad can be drilled, diced or custom formed to meet specific design requirements. AVX uses the same proven materials for IPC's that are used daily to formulate millions of quality MLC chip capacitors.

DISCRETE VS. SUBSTRATE PROCESSING

After Green Pad Fabrication, IPC's can be processed either individually or in larger substrates containing multiple parts. Typically, those IPC's that require additional thick film screen processes (i.e. multiple resistors, complex conductor patterns, etc.) are kept in larger substrates, called "Hermans", and sawed into discrete parts towards the end of processing. Other, simpler parts are sawed into discrettes in the green stage, fired and further processed.

THICK FILM RESISTORS

AVX uses thick film resistor inks which are capable of meeting higher quality standards. Different resistor inks can be used on the same IPC on either or both surfaces to provide a wide range of values. Laser trimming is available for tight tolerance requirements.

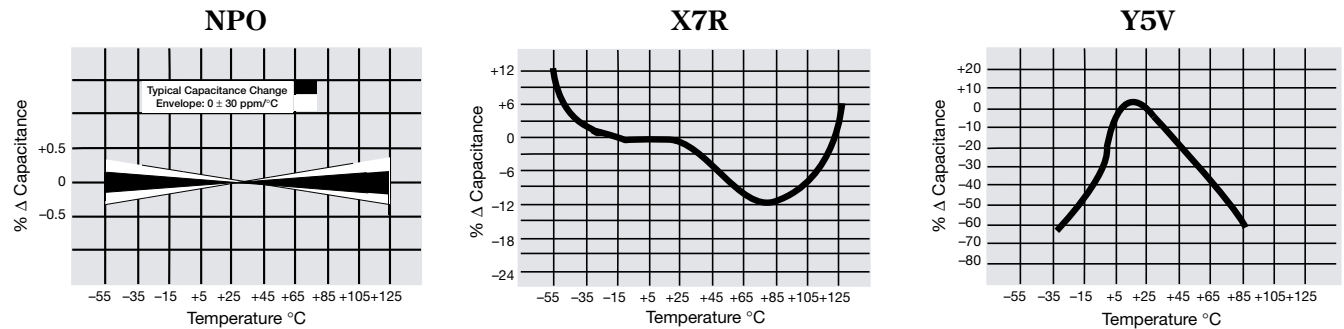
CAPACITOR SUBSTRATE PROPERTIES: Titanate Substrate vs. Alumina Performance

Property	94% Alumina	NPO	X7R	Y5V
Volume Resistivity (ohm-cm)	>10E14	5x10E12	5x10E12	1x10E12
Dielectric Constant	8.9	100	3500	15000
DF (25 degrees C, 1 MHz)	0.03%	0.15%	2.5%	5.0%
CTE (ppm/degree C)	7.2	10.5	12.0	9.0
Thermal Conductivity (25 degrees C, W/M degree K)	27.7	4 to 5	4 to 5	4 to 5

Mechanical Parameters

Parameter	Maximum	Minimum	Tolerance
Size	1" x 1"		Greater of ± 0.006 " / 1%
Thickness	.100"	.025"	± 0.003 "
Camber	.004"/in.	.001"/in.	-
External Pad Location	Dependent upon application . . . minimum spacing .030"		
CTE (ppm/degree C)	NPO-10.5	X7R-11.0	Y5V-10.0
Thermal Conductivity	All bodies 4 to 5 W/M degree K		
Termination Material	Thick Film: Pd/Ag, Ag		Plate: Ni/Au, Ni/Tin

DIELECTRIC TEMPERATURE CHARACTERISTICS



ELECTRICAL PROPERTIES: Capacitor Performance

Dielectric	NPO	X7R	Y5V
Max. Capacitance*	470pF	.047 μ F	0.1 μ F
Cap Tolerance	± 5 to 10% (value dependent)	± 10 to 20% (value dependent)	+80% -20%
WVDC	200V max.	200V max.	50V max.
DF (1KHz for WVDC \geq 25v)	0.15% max.	3.0% max.	5.0% max.
Typical TC Tracking	0.1%	1.0%	NA

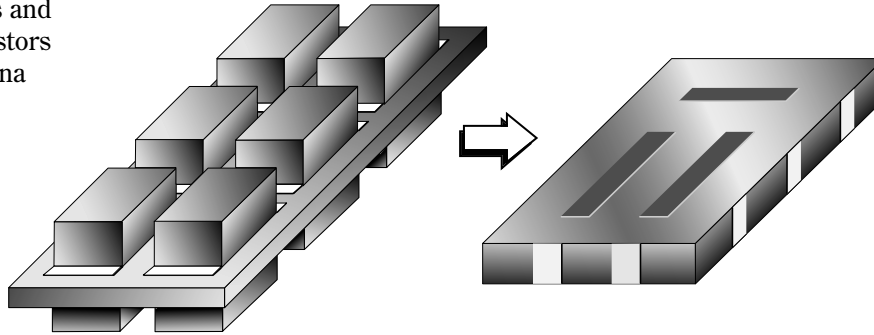
* MAXIMUM CAPACITANCE FOR EACH CAPACITOR IN THE 1206 FOUR CAPACITOR IPC EXAMPLE (OPPOSITE PAGE) AT 25VDC.

Resistor Performance

Values	10 ohms/square to 10M-ohm/square
Tolerances	$\pm 10\%$ Untrimmed, $\pm 1\%$ Trimmed (<10 Mohms)
Minimum Size	.025" x .035" off pad area
TCR	<220ppm/degree C

Component Size Reduction

Part with 6 Discrete
0504 Capacitors and
6 Discrete Resistors
on a .015 Alumina
Substrate



IPC Part with 6 Thick
Film Resistors
(3 Top, 3 Bottom)
on a Substrate
Integrating 6
Capacitors

FEATURES:

- Low Profile
- Surface Mountable
- MLC Construction
- Multiple Cap Values
- Thick Film Resistors
- Volumetrically Efficient
- Several Standard Designs
- Custom Designs Available

APPLICATIONS:

- Reduced Component Counts
 - Automotive
 - Telecommunications
 - Computers
- Reduced Board Space
 - Satellites
 - Portable Communications
 - PCMCIA
 - Medical Implantables

NOTICE: Specifications are subject to change without notice. Contact your nearest AVX Sales Office for the latest specifications. All statements, information and data given herein are believed to be accurate and reliable, but are presented without guarantee, warranty, or responsibility of any kind, expressed or implied. Statements or suggestions concerning possible use of our products are made without representation or warranty that any such use is free of patent infringement and are not recommendations to infringe any patent. The user should not assume that all safety measures are indicated or that other measures may not be required. Specifications are typical and may not apply to all applications.

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